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## INTERVERTEBRAL DISC PROSTHESIS

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### Abstract of WO2005074839

The present invention relates to an intervertebral disc prosthesis comprising at least three pieces including an upper plate (1), a lower plate (2) and a mobile core (3) at least relative to the lower plate, the upper surface of the core being in contact with at least a part of the lower surface of the upper plate, cooperation means (22, 31) limiting or preventing the movements of the core relative to the lower plate, in translation and in rotation, respectively, along an axis substantially parallel to the lower plate and about an axis substantially perpendicular to the lower plate, characterised in that at least the lower surface of the core has at least one hole (41) facilitating sliding of the core relative to the upper surface of the lower plate with which it is in contact.

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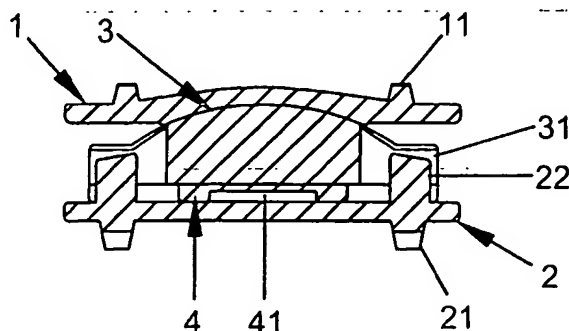
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(57) Abstract: The present invention relates to an inter-  
vertebral disc prosthesis comprising at least three pieces  
including an upper plate (1), a lower plate (2) and a mo-  
bile core (3) at least relative to the lower plate, the upper  
surface of the core being in contact with at least a part of  
the lower surface of the upper plate, cooperation means  
(22, 31) limiting or preventing the movements of the core  
relative to the lower plate, in translation and in rotation,  
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lower plate and about an axis substantially perpendicu-  
lar to the lower plate, characterised in that at least the  
lower surface of the core has at least one hole (41) facil-  
itating sliding of the core relative to the upper surface of  
the lower plate with which it is in contact.

## INTERVERTEBRAL DISC PROSTHESIS

The present invention relates to an intervertebral disc prosthesis, intended to be substituted for fibro-cartilaginous discs ensuring a bond  
5 between the vertebrae of the spinal column, in particular in the region of the cervical spine.

Various types of prostheses are known in the prior art. Numerous prostheses are constituted by a lower plate and an upper plate enclosing a central core. A part of these prostheses enables the upper plate to slide  
10 relative to the central core and optionally permits the central core to slide relative to the lower plate. This sliding of the central core relative to the lower plate is an essential characteristic, as it must allow spontaneous positioning of the core in the ideal position to absorb constraints imposed on the prosthesis, during movements made by the patient carrying the prosthesis.  
15 However, because of the forces from applied constraints, materials utilised and the form of the different pieces constituting the prosthesis, the sliding of the core is often difficult, which causes rapid wear and risks of ejecting at least a part of the prosthesis to the outside of the spine, and this is not desirable for the patient.

20 The aim of the present invention is to eliminate certain disadvantages of the prior art by proposing an intervertebral disc prosthesis allowing limited movements of the different pieces of the prosthesis between one another, but whereof the sliding of the core is facilitated to improve the behaviour of the prosthesis during application of constraints on the latter.

25 This aim is achieved by an intervertebral disc prosthesis comprising at least three pieces including a first plate, a second plate and a core mobile at least relative to one of the plates, the core having a curved surface in contact with at least a part of a complementary curved surface of the first plate and a substantially flat surface in contact with at least a part of a substantially flat  
30 surface of the second , cooperation means situated near the periphery of the second plate and of the core allowing to limit or prevent, without excessive friction, the movements in translation of the core relative to the second plate,

along an axis substantially parallel to the substantially flat surfaces, and allowing to limit or prevent the movements in rotation of the core relative to the second plate, about an axis substantially perpendicular to the substantially flat surfaces, characterised in that at least the substantially flat surface of the core has at least one dummy hole facilitating sliding of the core relative to the substantially flat surface of the second plate with which it is in contact.

According to another particular feature, at least the substantially flat surfaces are the lower surface of the core and the upper surface of the second plate, known as lower plate.

According to another particular feature, at least the substantially flat surface of the core is enclosed in a protective shell, whereof the surface in contact with the substantially flat surface of the second plate and with the substantially flat of the core has at least one hole.

According to another particular feature, the protective shell of the core does not cover the cooperation means of the core, so as to avoid contact of the protective shell with the cooperation means of the second plate.

According to another particular feature, the area of contact of the substantially flat surface of the core or of the protective shell with the substantially flat surface of the second plate and the area of contact of the curved surface of the core with the curved surfaces of the first plate are substantially equal, on both sides of the core.

According to another particular feature, the angle formed by the edges of the hole present at least on the substantially flat surface of the core or of the protective shell of the core is softened to improve the sliding of the core or of the shell on the substantially flat surface of the second plate.

According to another particular feature, the hole present on the substantially flat surface of the core or of the protective shell of the core is prolonged, as far as the periphery of this substantially flat surface, by grooves forming channels via which the interstitial liquid from surrounding

tissue can play a lubricating role to improve the sliding of the core on the substantially flat surface of the second plate, when the prosthesis is in place on the patient.

According to another particular feature, the angle formed by the edges  
5 of the grooves prolonging the hole as far as the periphery of the substantially flat surface of the core or of the protective shell of the core is softened to improve the sliding of the core or of the shell on the substantially flat surface of the second plate.

According to another particular feature, the core is made of  
10 polyethylene.

According to another particular feature, the protective shell of the core is made of metal.

According to another particular feature, the first and second plates are made of metal.

According to another particular feature, the cooperation means consist  
15 in male means of the second plate, cooperating with female means of the core.

According to another particular feature, the core is mobile relative to the first and/or second plates and that a variable angle between the first and  
20 second plates depends on the position of the core, an inclination, in any direction at all, of at least the first plate inducing the displacement of the core between the plates and providing freedom of movement for the patient and, at the same time, helping eliminate the positioning defects of the prosthesis.

According to another particular feature, an angle between the upper  
25 surface of the upper plate and the lower surface of the lower plate can be imposed either by the fact that the plane means representing the upper and lower surfaces of the core form an angle, or by the fact that the plane means representing the upper and lower surfaces of the first plate and/or of the second plate form an angle, or by restriction of the movements of the core  
30 about a position imposing inclination of at least the first plate.

According to another particular feature, the same plates can be assembled with cores of different thicknesses.

According to another particular feature, at least a part of the surface of the first plate is concave and complementary to the surface of the core with  
5 which it is in contact.

According to another particular feature, the dimensions of each male means are slightly less than those of each female means so as to permit slight clearance between the core and the second plate.

According to another particular feature, the dimensions of each male  
10 means are substantially the same as those of each female means so as to prevent any clearance between the core and the second plate.

According to another particular feature, the male means of the second plate are two contact plates situated opposite one another on two edges of the prosthesis, and the female means of the core are two recesses.

15 According to another particular feature, the male means of the second plate are two walls situated opposite one another in the vicinity of two edges of the prosthesis, and in that the female means of the core are recesses.

According to another particular feature, the male means of the lower plate are two nibs curved towards the interior of the prosthesis and situated  
20 opposite one another on two edges of the prosthesis, and the female means of the core are two recesses.

According to another particular feature, at least one of the nibs is replaced by a pin equipped with a hole and on which a plate is fixed by means of a dowel penetrating the hole.

25 According to another particular feature, the lower surface of the lower plate and the upper surface of the upper plate are provided with teeth or notches situated in the vicinity of at least two edges of the prosthesis and oriented so as to prevent sliding of the prosthesis prior to its adhesion to the

osseous tissue permitted by a porous biocompatible coating of the surfaces of the plates in contact with the vertebrae.

According to another particular feature, at least the second plate comprises one or more openings in the vicinity of its front side, provided to  
5 receive anchoring means of the prosthesis in a vertebra.

According to another particular feature, the openings of the second plate are circular, and in that the anchoring means have the form of a stud.

According to another particular feature, the head of the anchoring means have larger dimensions than the openings of the second plate, the  
10 anchoring means being fixed into a vertebra, the second plate is sandwiched in between the head of the anchoring means and said vertebra.

According to another particular feature, the upper plate is bulged on at least a part of its upper surface to adapt to the form of the vertebrae.

Another aim of the invention is to propose an insertion device,  
15 between two vertebrae, of intervertebral disc prostheses constituted by a lower plate, an upper plate and a mobile core at least relative to the lower plate. It would be advantageous for the prosthesis insertion device between two vertebrae to allow the prosthesis to be kept sterile, to position it facing the opening made by the surgeon between the two vertebrae, to have it enter  
20 this opening by translation then to withdraw the device leaving the prosthesis inserted in its opening.

This aim is attained by an insertion device, between two vertebrae, of intervertebral disc prostheses constituted by a first plate, an second plate and a mobile core at least relative to the second plate, characterised in that it  
25 comprises a clip whereof the front surface has a form provided to fit the form of the front edge of the prosthesis and whereof at least two edges are equipped with gripping means of the prosthesis.

According to another particular feature, the gripping means present on at least two edges of the clip are two flexible blades mounted on the lateral

edges of the clip and holding the prosthesis by pinching the lateral edges of the upper and lower plates of the prosthesis.

According to another particular feature, the front surface of the clip has a form provided to fit the form of the front edge of the prosthesis, on one hand, owing to its height at least substantially equal to the height of the prosthesis, so as to come into contact with the front edges of each of the plates of the prosthesis and, on the other hand, to at least one groove in at least the median part of the front surface of the clip to likewise come in contact with the front edge of the core which is slightly set back relative to the front edges of the plates.

According to another particular feature, the rear surface of the clip can be pushed by a first end of a rod, known as a guide, equipped with a pusher at its other end and with a limit stop at a variable position along the guide for limiting the length of the sliding of the guide inside a body of a charger equipped with a head in which is arranged a space dimensioned for receiving the prosthesis and the clip, the position of the limit stop on the guide being adjustable such that the prosthesis, held by the clip, exits from the head of the charger and is centred relative to the vertical axis of the two vertebrae between which it must be implanted when the limit stop contacts the body of the charger.

According to another particular feature, the front end of the gripping means of the prosthesis present on at least two edges of the clip is larger than their back end at which the width of the clip is substantially equal to the width of the space in the head of the charger, such that, when the prosthesis and the clip are in the head of the charger, the prosthesis is held firmly by the gripping means of the clip which are then compressed between the prosthesis and the internal wall of the space arranged in the head of the charger and, when the prosthesis exits from the head of the charger, it is held less firmly by the clip, so as to be able to be released therefrom.



Other particular features and advantages of the present invention will emerge more clearly from the description hereinbelow, given in reference to the attached drawings, in which:

Figure 1a illustrates a perspective view of the prosthesis according to an embodiment of the invention, viewed from the front, Figure 1b illustrates a top view of the prosthesis with the planes of section A-A and B-B, respectively of Figures 1c and 1d,

Figure 2a illustrates a top view of the core equipped with its protective shell in an embodiment of the invention, with the planes of sections A-A and B-B, respectively of Figures 2b and 2c, Figures 2d and 2e illustrate, in perspective, respectively, a top view and a bottom view of the core equipped with its protective shell,

Figures 3a and 3b illustrate respectively a profile view and a top view in perspective of the core deprived of its protective shell in an embodiment of the invention, Figures 3c and 3d illustrate, in perspective, respectively, a top view and a bottom view of the protective shell of the core according to an embodiment of the invention,

Figure 4a illustrates a bottom view of the upper plate of the prosthesis, with the planes of sections A-A and B-B, respectively of Figures 4c and 4d, Figure 4b illustrates a side view of the upper plate of the intervertebral disc prosthesis according to an embodiment of the invention,

Figure 5a illustrates a top view of the lower plate of the prosthesis, Figures 5b and 5c illustrate respectively side views and front views of the lower plate of the prosthesis and Figures 5d and 5e illustrate, in perspective, respectively, a top view and a bottom view of the lower plate of the intervertebral disc prosthesis according to an embodiment of the invention,

Figure 6a illustrates a view in perspective of the clip of the insertion device of intervertebral disc prostheses between two vertebrae, Figures 6b and 6c illustrate a partial profile and top view, respectively, of the head of the charger of the prosthesis insertion device between two vertebrae, with the prosthesis held by the clip in extended position, Figure 6d illustrates a view in

perspective of the clip of the insertion device of intervertebral disc prostheses between two vertebrae.

Figure 7a illustrates a top view of the complete prosthesis insertion device between two vertebrae when the prosthesis held by the clip is retracted into the head of the charger, Figure 7b illustrates it according to the section plan D-D of Figure 7a, Figure 7c illustrates a top view of the complete prosthesis insertion device between two vertebrae when the prosthesis held by the clip is extended from the head of the charger and Figure 7d illustrates it according to the section plan D-D of Figure 7c.

10

The intervertebral disc prosthesis according to the present invention is constituted by a first plate (1) articulated relative to a second plate (2) by means of a core (3), as evident in particular in Figures 1a, 1c and 1d. In the following description, the first plate (1) is called the upper plate and the second plate (2) is called the lower plate, according to the orientation given to the prosthesis shown in the drawings. It is obvious that, without departing from the scope of the present invention, the prosthesis herein described could be inversely oriented between the vertebrae, so that the first plate (1) would be the lower plate and the second plate (2) would be the upper plate. An advantage of the prosthesis according to the present invention is that it comprises simple pieces which can be dimensioned so that the prosthesis is placed on the cervical spine.

20

The core (3) is of slight thickness (for example 3 mm) for a cervical prosthesis or thicker (for example 15 mm) for a lumbar prosthesis.

25

In a variant embodiment, a part of the upper surface of the upper plate (1) is bulged, as shown in Figures 4b to 4d, so as to better adapt to the vertebra on which the prosthesis is intended to be placed, the lower surface of the vertebrae being hollow. The bulged part of the upper plate (1) is then situated in the front part of the upper plate, as shown in particular in Figure 4d. The lower plate (2) is substantially flat. In fact, its lower surface has no need to be bulged or hollow, since the upper surface of the vertebrae is substantially flat.

30

In the embodiment of Figures 1a to 1d, 4b to 4d and 5b to 5e, the upper surface of the upper plate (1) and the lower surface of the lower plate (2) are provided with teeth or notches (11, 21) situated in the region of at least two edges of the prosthesis. These notches (11, 21), oriented so as to prevent sliding of the prosthesis, serve as anchoring means for the prosthesis at times when the osseous tissue adheres to these surfaces of the plates in contact with the vertebrae. In fact, the osseous tissue, in the few weeks following surgical intervention for implanting the prosthesis, will invade the surfaces with which it is in contact. A porous biocompatible coating is provided on these surfaces to allow adhesion of the osseous tissue and its definitive fusion with the prosthesis.

An embodiment comprising all the possible elements according to the present invention will now be described hereinafter. In this embodiment, the lower surface of the core (3) is enclosed by a protective shell (4) of the core. This protective shell (4) is, for example, drilled, in the centre of its lower surface, with at least one hole (41), for example a dummy, which improves sliding on the upper surface of the lower plate (2). In a simpler variant embodiment, in the absence of this protective shell (4), it is the lower surface of the core (3) which, for example, will be pierced by a dummy hole in its centre. The core alone will then have substantially the same appearance as the ensemble made up by the core (3) and its protective shell (4), such as in the embodiment described hereinafter and illustrated in Figures 2a to 2e. The size and form, for example oval, of the hole (41) through the core (3) or the protective shell (4) are adapted to the size and form of the core or of the protective shell. The hole will have been made so that the angles formed by its edges (411) are softened to reduce friction on the lower plate. This hole (41) of adapted dimensions can of course be replaced by a plurality of smaller holes, whereof the extent will be adapted to the size and form of the core or of the protective shell. For example, a multitude of concave minuscule alveoli could be arranged on the lower surface of the core or of the protective shell.

In a variant embodiment the dummy hole (41) present at least on the lower surface of the core (3) or of the protective shell (4) of the core is prolonged by grooves (410) which extend as far as the periphery of this lower surface. These grooves (410) thus form channels via which interstitial liquid  
5 from surrounding tissue can slide between the lower surface of the core (3) or of the protective shell (4) and play a lubricating role to improve sliding of the core (3) on the upper surface of the lower plate (2).

The hole (41) and the eventual grooves (410) may be such that the area of contact between the lower surface of the core (3) and the upper  
10 surface of the lower plate (2) are substantially to the area of contact between the upper surface of the core (3) and the lower surface of the upper plate (1). The constraints applied to the prosthesis will thus be absorbed equally by both surfaces of the core (3) in this embodiment, which will allow reducing frictions and improving the life duration of the core by optimizing the  
15 displacement of the core (3) relative to the plates (1, 2).

In the embodiment where the lower surface of the core (3) is enclosed by a protective shell (4), the lower part of the core is narrower than its upper part, such that once the protective shell (4) is mounted on the lower part, the core has substantially homogeneous dimensions, as shown in Figures 2a to  
20 2e. On the circumference of the core, substantially at the centre of its thickness, a groove (33), shown in Figures 2b, 2c and 3a, complementary to a groove (43), illustrated in Figures 2b, 2c and 3c, present on the internal part of the edges of the protective shell (4), ensures cohesion of the ensemble made up by the core (3) and its protective shell (4). The core (3) will then be  
25 simply encased in the protective shell (4) when the prosthesis is mounted.

The core (3) has, on at least one part of its upper surface, a convex part (32), evident particularly in Figures 2a to 2d, 3a and 3b, complementary to a concave part (12) of the upper plate (1), evident particularly in Figures 4a, 4c and 4d. This concave part (12) permits inclination of the upper plate  
30 (1) when the patient wearing the prosthesis bends over. The lower surface of the core (3) or of the protective shell (4) and the upper surface of the lower plate (2) could be plane, or substantially flat, so as to permit clearance of the

core (3) relative to the lower plate (2), both in translation according to an axis substantially parallel to the lower plate (2), and in rotation about an axis substantially perpendicular to the lower plate (2). During movements made by the patient wearing the prosthesis, this inclination of the upper plate (1) and this clearance of the core will allow displacement of the core (3) towards the ideal position to absorb the constraints applied to the prosthesis. The movement between the upper plate (1) and the core (3), as well as the clearance of the core (3) relative to the lower plate (2) thus allow the patient to move, and, optionally, to eliminate the defects of positioning the prosthesis. This clearance likewise has the advantage of preventing premature wear due to the constraints applied to the prosthesis. The dummy hole (41) bored in the lower surface of the core (3) or of the protective shell (4) will help improve sliding of the core on the upper surface of the lower plate, so that the core can find the ideal position for absorbing the constraints imposed on the prosthesis as fast and as easily as possible. For good absorption of the constraints, the core (3) could, for example, be made of polyethylene, a compressible material simulating the physical properties of elasticity of natural intervertebral discs.

According to an embodiment of the invention, the lower surface of a core (3) made of compressible material could be enclosed by a metallic protective shell (4), permitting better sliding on the lower metallic plate (2) and reduction in creep of the compressible material. The sliding of the core will be improved by a hole (41), for example a dummy, bored in the lower surface of the protective shell (4).

In the embodiment of Figures 1a, 1c and 5a to 5e the lower plate (2) comprises two contact plates (22) situated opposite one another on two edges of the lower plate (2), at each lateral sides of the lower plate (2). Each contact plate (22) constitutes male cooperation means of the lower plate (2) and each can penetrate female cooperation means of the core, constituted by a recess (31) of the core (3) on two of its edges. In the embodiment shown in these figures, the dimensions of each recess (31) of the core (3) are slightly greater than those of each nib (22) of the lower plate (2) so as to

limit clearance of the core (3) relative to the lower plate (2), both in translation along an axis substantially parallel to the lower plate (2), and in rotation about an axis substantially perpendicular to the lower plate (2).

In the embodiment where a core (3) made of compressible material is provided with a protective metallic shell (4) sliding on a lower metallic plate, the protective shell could be in an adapted form so that it is never in contact with the metallic cooperation means of the lower plate. Such a result can be obtained, for example, thanks to the fact that the edges of the protective shell (4) are slightly offset from the cooperation means of the core. This variant embodiment can prove necessary since, in a living organism, it is preferable to avoid the shocks between two metallic materials, which risk projecting metallic particles into the surrounding tissue and causing complications.

In a variant embodiment not shown, the dimensions of each recess (31) of the core (3) are substantially the same as those of each nib (22) of the lower plate (2), so as to avoid any clearance of the core (3) relative to the lower plate (2), both in translation and in rotation. In the latter case, the only permitted movement of the prosthesis is that of the upper plate (1) relative to the core (3).

In a variant embodiment not shown, the contact plates (22) are replaced by nibs curved towards the interior of the prosthesis, above the edges of the core (3), so as to prevent the core from being raised. In another variant, one of the nibs is replaced by a contact plate (or pin) equipped with a hole in which, for example, a dowel fixes a plate (or hasp). The ensemble made up by the hasp fixed on the contact plate will have the same form as the nib of the opposite side and will fulfil the same function with the added advantage of facilitating mounting of the different pieces of the prosthesis. In a variant embodiment, the two nibs are each replaced by a contact plate to which a hasp is fixed.

In another variant embodiment not shown, the contact plates (22) of the lower plate (2) are replaced by half dog points. The core (3), by way of complement, does not comprise recesses (31), but two wells under its lower surface. The dimensions of the half dog points of the lower plate (2) and of

the wells of the core (3) will be adapted according to the desired result, by choice, of slight clearance of the core in translation and in rotation or any clearance.

In another embodiment not shown, the contact plates (22) of the lower plate (2) are replaced by walls, positioned opposite one another, in the vicinity of two substantially parallel edges of the lower plate, but more towards the interior of the prosthesis than the contact plates (22). The core (3) comprises recesses complementary to the walls. The dimensions of each recess of the core of this embodiment are, either slightly greater, or substantially the same as those of each wall of the lower plate, so as to allow or not slight clearance in translation and in rotation.

In yet another embodiment not shown, the female cooperation means are situated on the lower plate (2) and the male cooperation means on the core (3).

The intervertebral disc prosthesis according to the present invention in particular helps correct the defects of lordosis. The presence of an acute angle, for example of between  $0^{\circ}$  and  $15^{\circ}$ , in the postero-anterior direction, between the upper plate (1) and the lower plate (2) of the prosthesis could be desired. To adjust the angle necessary as a function of the patient, it suffices to select a core (3) with an appropriate angle between the average plane representing its upper surface and the plane passing through its lower surface. Such an angle could likewise be obtained by making an upper plate, including the plane means representing its lower and upper surfaces forming an angle. Another possibility involves the lower plate whereof the plane means representing its lower and upper surfaces form an angle. Finally, another possibility is permitted only by prostheses of the same type as that according to the present invention and consists of a position of the core slightly offset to the rear or the front relative to the centre of the prosthesis including the plates which will then form an angle. This slightly offset position of the core can, for example, be maintained due to adjustable positioning of the male and female cooperation means.

In the event where the male elements in the vicinity of the edges of the core (i.e., near the periphery of the core) and the female elements are situated in the vicinity of the edges of the lower plate (i.e., near the periphery of the lower plate), a lordosis core (by the fact that it forms an acute angle in the postero-anterior direction) can then be made solid with the plate by a projection penetrating a cavity or opening in the lower plate. If the surgeon wants lordosis determined for a patient, he will select a core (3) which cannot have any clearance relative to the lower plate (2). However, if he only wants the lordosis to remain within a range of values, he will select a core which can have slight clearance in translation and in rotation relative to the lower plate (2), but about a position imposing slight permanent inclination of at least one of the plates.

The intervertebral disc prosthesis according to the present invention can, in a variant embodiment, be anchored solidly, from when it is implanted, in the vertebral column to prevent the prosthesis from migrating under the effect of the resulting transversal of the force exerted by the vertebral column on the prosthesis in place, which is that much more important than lordosis. In this case, the lower plate (2) comprises one or more openings situated in the vicinity of the rear side of the prosthesis, receiving anchoring means.

Therefore, in a variant embodiment, the openings in the lower plate (2) are circular and the anchoring means have the shape of studs, with a head having a size greater than that of the openings to allow the lower plate (2) to be sandwiched between the head of the anchoring means and the vertebra on which the prosthesis is anchored. For greater security, the openings could be made such that the anchoring means and the lower plate form an angle of less than or equal to  $90^\circ$ .

The intervertebral disc prostheses are not easy to implant in the patient. This difficulty is exacerbated by the fact of the mobility of the pieces of the prostheses making up a lower plate, an upper plate and a mobile core at least relative to the lower plate. It is thus significant to associate these prostheses with a device allowing it to be held and inserted between the vertebrae. Such a device according to the present invention is made up of a



clip (7) whereof the front surface (71) has a shape provided to fit the form of the front edge of the prosthesis. This clip (7) has on at least two of its edges gripping means (72) of the prosthesis. These gripping means (72) can, for example, be two (72) flexible blades mounted on the lateral edges of the clip  
5 and can hold the prosthesis by pinching the lateral edges of the upper and lower plates of the prosthesis. The front surface (71) of the clip (7) has, for example, a height at least substantially equal to the height of the prosthesis, so as to come into contact with the front edges of each of the plates of the prosthesis.

10 In an embodiment of the invention, a groove (711) is present in the median part of the front surface (71) of the clip (7) so as to come into contact with the front edge of the core, slightly set back relative to the front edges of the plates. There can of course be several grooves fitting the shape of the prosthesis. The front surface (71) of the clip (7) provided with the groove  
15 (711) thus perfectly fits the form of the front edge of the prosthesis when in contact with the three elements making up the prosthesis. The clip thus helps hold the prosthesis and push it homogeneously towards its opening between two vertebrae. This clip (7) is provided to hold the prosthesis and to be inserted into a charger (6) (or loader as referring to means for loading the  
20 prosthesis held by the clip). This charger (6) has a head (62) in which a space is arranged to receive the clip holding the prosthesis and a body (61) provided to slide about a rod, called a guide (5). The rear surface of the clip (7) can be provided with a hole in its centre, provided to insert an end (54) of the guide (5) so that the guide (5) can hold and push the clip (7). The guide  
25 (5) is equipped with a pusher (52) at its other end, which will help push the clip and the prosthesis out of the head (62) of the charger (6) by having the guide (5) slide in the body (61) of the charger (6). A Limit stop is mounted on the guide (5) in a position adjustable. For example, threaded ring (53) is screwed around the guide by screwing. This ring serves as a limit stop (53) to  
30 the guide when it slides in the body (61) of the charger (6). The position of the limit stop (53) will be adjusted, as a function of the size of the vertebra, so that when the limit stop (53) of the guide (5) comes into contact with the body

(61) of the charger (6), the end (54) of the guide (5) will have pushed the clip (7) as far as a position where the prosthesis, held by the flexible blades (72) of the clip, is now out of the head (62) of the charger (6) and centred relative to the axis of the vertebral column.

5 In an embodiment of the prosthesis according to the invention, as described earlier, the upper (1) and lower (2) plates are provided with teeth or notches (11 and 21) on their surface in contact with the vertebrae. These notches (11, 21) are oriented so as to oppose displacement of the prosthesis in the direction of withdrawal of the clip (7), once the prosthesis is entered in  
10 its opening between two vertebrae, made in advance by the surgeon. These notches (11, 21) are thus oriented so as to allow the prosthesis to return to its opening but not come out when the surgeon pulls back the clip (7) holding the prosthesis. On the other hand, the front end of the gripping means (72) of the prosthesis present on at least two edges of the clip (7) is larger (thicker)  
15 than their back end. The width of the clip at its back end is substantially equal to (or slightly smaller than) the width of the space in the head (62) of the charger (6). Thanks to these substantially equal dimensions of the space inside the head (62) of the charger (6) and of the prosthesis and the clip (7), when both the latter are in the head (62) of the charger (6), the prosthesis is  
20 solidly held by the flexible blades (72) of the clip (7) whereof the front ends are compressed between the prosthesis and the internal wall of the space made in the head (62) of the charger (6). When the surgeon presses on or strikes the pusher (52) of the guide, the prosthesis exits from the head (62) of the charger and it is held less firmly by the clip (7) since the back ends of the  
25 flexible blades (72) are less compressed than were the front ends. The prosthesis could then be released from the clip by pulling back the insertion device, owing to the presence of the notches on the lower and upper plates, allowing the prosthesis to remain in its opening between the two vertebrae.

It must be evident for specialists that the present invention allows  
30 embodiments in numerous other specific forms without departing from the scope of application of the invention as claimed. As a consequence, the present embodiments must be considered by way of illustration, but can be

modified within the scope defined by the range of the attached claims, and the invention does not have to be limited to the details given hereinabove.

### Claims

1. An intervertebral disc prosthesis comprising at least three pieces including a first plate (1), a second plate (2) and a core mobile (3) at least  
5 relative to one of the plates (1, 2), the core (3) having a curved surface in contact with at least a part of a complementary curved surface of the first plate (1) and a substantially flat surface in contact with at least a part of a substantially flat surface of the second (2), cooperation means (22, 31)  
10 situated near the periphery of the second plate (2) and of the core (3) allowing to limit or prevent, without excessive friction, the movements in translation of the core relative to the second plate, along an axis substantially parallel to the substantially flat surfaces, and allowing to limit or prevent the movements in rotation of the core relative to the second plate, about an axis substantially perpendicular to the substantially flat surfaces,  
15 characterised in that at least the substantially flat surface of the core (3) has at least one dummy hole (41) facilitating sliding of the core (3) relative to the substantially flat surface of the second plate (2) with which it is in contact.

2. The intervertebral disc prosthesis as claimed in Claim 1, characterised in that at least the substantially flat surfaces are the lower  
20 surface of the core (3) and the upper surface of the second plate (2), known as lower plate.

3. The intervertebral disc prosthesis as claimed in any one of Claims 1 and 2, characterised in that at least the substantially flat surface of the core (3) is enclosed in a protective shell (4), whereof the surface in contact with  
25 the substantially flat surface of the second plate (2) and with the substantially flat of the core (3) has at least one hole (41).

4. The intervertebral disc prosthesis as claimed in Claim 3, characterised in that the protective shell (4) of the core does not cover the cooperation means (31) of the core, so as to avoid contact of the protective  
30 shell (4) with the cooperation means (22) of the second plate (2).

5 5. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 4, characterised in that the area of contact of the substantially flat surface of the core (3) or of the protective shell (4) with the substantially flat surface of the second plate (2) and the area of contact of the curved surface of the core (3) with the curved surfaces of the first plate (1) are substantially equal, on both sides of the core (3).

10 6. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 5, characterised in that the angle formed by the edges (411) of the hole (41) present at least on the substantially flat surface of the core (3) or of the protective shell (4) of the core (3) is softened to improve the sliding of the core (3) or of the shell (4) on the substantially flat surface of the second plate (2).

15 7. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 6, characterised in that the hole (41) present on the substantially flat surface of the core (3) or of the protective shell (4) of the core is prolonged, as far as the periphery of this substantially flat surface, by grooves (410) forming channels via which the interstitial liquid from surrounding tissue can play a lubricating role to improve the sliding of the core (3) on the substantially flat surface of the second plate (2), when the prosthesis is in place on the patient.

20 8. The intervertebral disc prosthesis as claimed in Claim 7, characterised in that the angle formed by the edges (411) of the grooves (410) prolonging the hole (41) as far as the periphery of the substantially flat surface of the core (3) or of the protective shell (4) of the core is softened to improve the sliding of the core (3) or of the shell (4) on the substantially flat surface of the second plate (2).

9. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 8, characterised in that the core (3) is made of polyethylene.

10. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 9, characterised in that the protective shell (4) of the core (3) is made of metal.

5 11. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 10, characterised in that the first (1) and second (2) plates are made of metal.

12. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 11, characterised in that the cooperation means consist in male means (22) of the second plate (2), cooperating with female means (31) of the core  
10 (3).

13. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 12, characterised in that the core (3) is mobile relative to the first (1) and/or second (2) plates and that a variable angle between the first (1) and second (2) plates depends on the position of the core (3), an inclination, in any  
15 direction at all, of at least the first plate (1) inducing the displacement of the core (3) between the plates (1, 2) and providing freedom of movement for the patient and, at the same time, helping eliminate the positioning defects of the prosthesis.

14. The intervertebral disc prosthesis as claimed in any one of Claims 1  
20 to 13, characterised in that an angle between the upper surface of the upper plate (1, 2) and the lower surface of the lower plate (2, 1) can be imposed either by the fact that the plane means representing the upper and lower surfaces of the core (3) form an angle, or by the fact that the plane means representing the upper and lower surfaces of the first plate (1) and/or of the  
25 second plate (2) form an angle, or by restriction of the movements of the core (3) about a position imposing inclination of at least the first plate (1).

15. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 14, characterised in that the same plates (1, 2) can be assembled with cores (3) of different thicknesses.

16. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 15, characterised in that at least a part of the surface of the first plate (1) is concave and complementary to the surface of the core (3) with which it is in contact.

5        17. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 16, characterised in that the dimensions of each male means are slightly less than those of each female means so as to permit slight clearance between the core (3) and the second plate (2).

10       18. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 17, characterised in that the dimensions of each male means are substantially the same as those of each female means so as to prevent any clearance between the core (3) and the second plate (2).

15       19. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 18, characterised in that the male means (22) of the second plate (2) are two contact plates situated opposite one another on two edges of the prosthesis, and the female means (31) of the core (3) are two recesses.

20       20. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 18, characterised in that the male means (22) of the second plate (2) are two walls situated opposite one another in the vicinity of two edges of the prosthesis, and in that the female means (31) of the core (3) are recesses.

25       21. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 18, characterised in that the male means (22) of the lower plate (2) are two nibs curved towards the interior of the prosthesis and situated opposite one another on two edges of the prosthesis, and the female means (31) of the core (3) are two recesses.

22. The intervertebral disc prosthesis as claimed in Claim 21, characterised in that at least one of the nibs is replaced by a pin equipped with a hole and on which a plate is fixed by means of a dowel penetrating the hole.

23. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 22, characterised in that the lower surface of the lower plate (2, 1) and the upper surface of the upper plate (1, 2) are provided with teeth or notches (21, 11) situated in the vicinity of at least two edges of the prosthesis and oriented  
5 so as to prevent sliding of the prosthesis prior to its adhesion to the osseous tissue permitted by a porous biocompatible coating of the surfaces of the plates (1, 2) in contact with the vertebrae.

24. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 23, characterised in that at least the second plate (2) comprises one or  
10 more openings in the vicinity of its front side, provided to receive anchoring means of the prosthesis in a vertebra.

25. The intervertebral disc prosthesis as claimed in Claim 24, characterised in that the openings of the second plate (2) are circular, and in that the anchoring means have the form of a stud.

15 26. The intervertebral disc prosthesis as claimed in any one of Claims 24 and 25, characterised in that the head of the anchoring means have larger dimensions than the openings of the second plate (2), the anchoring means being fixed into a vertebra, the second plate (2) is sandwiched in between the head of the anchoring means and said vertebra.

20 27. The intervertebral disc prosthesis as claimed in any one of Claims 1 to 26, characterised in that the upper plate is bulged on at least a part of its upper surface to adapt to the form of the vertebrae.

28. An insertion device, between two vertebrae, of intervertebral disc prostheses constituted by a first plate (1), an second plate (2) and a mobile  
25 core (3) at least relative to the second plate (2), characterised in that it comprises a clip (7) whereof the front surface (71) has a form provided to fit the form of the front edge of the prosthesis and whereof at least two edges are equipped with gripping means (72) of the prosthesis.

29. The device as claimed in Claim 28, characterised in that the  
30 gripping means (72) present on at least two edges of the clip (7) are two



flexible blades mounted on the lateral edges of the clip and holding the prosthesis by pinching the lateral edges of the upper (1) and lower (2) plates of the prosthesis.

30. The device as claimed in any one of Claims 28 and 29,  
5 characterised in that the front surface (71) of the clip (7) has a form provided to fit the form of the front edge of the prosthesis, on one hand, owing to its height at least substantially equal to the height of the prosthesis, so as to come into contact with the front edges of each of the plates of the prosthesis and, on the other hand, to at least one groove (711) in at least the median  
10 part of the front surface of the clip to likewise come in contact with the front edge of the core (3) which is slightly set back relative to the front edges of the plates.

31. The device as claimed in any one of Claims 28 to 30, characterised in that the rear surface of the clip (7) can be pushed by a first end of a rod  
15 (51), known as a guide (5), equipped with a pusher (52) at its other end and with a limit stop (53) at a variable position along the guide (5) for limiting the length of the sliding of the guide inside a body (61) of a charger (6) equipped with a head (62) in which is arranged a space dimensioned for receiving the prosthesis and the clip (7), the position of the limit stop (53) on the guide (5)  
20 being adjustable such that the prosthesis, held by the clip (7), exits from the head (62) of the charger (6) and is centred relative to the vertical axis of the two vertebrae between which it must be implanted when the limit stop (53) contacts the body (61) of the charger (6).

32. The device as claimed in any one of Claims 28 to 31, characterised  
25 in that the front end of the gripping means (72) of the prosthesis present on at least two edges of the clip (7) is larger than their back end at which the width of the clip (7) is substantially equal to the width of the space in the head (62) of the charger (6), such that, when the prosthesis and the clip (7) are in the head (62) of the charger (6), the prosthesis is held firmly by the gripping  
30 means (72) of the clip (7) which are then compressed between the prosthesis and the internal wall of the space arranged in the head (62) of the charger

and, when the prosthesis exits from the head (62) of the charger, it is held less firmly by the clip (7), so as to be able to be released therefrom.

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FIGURE 1A

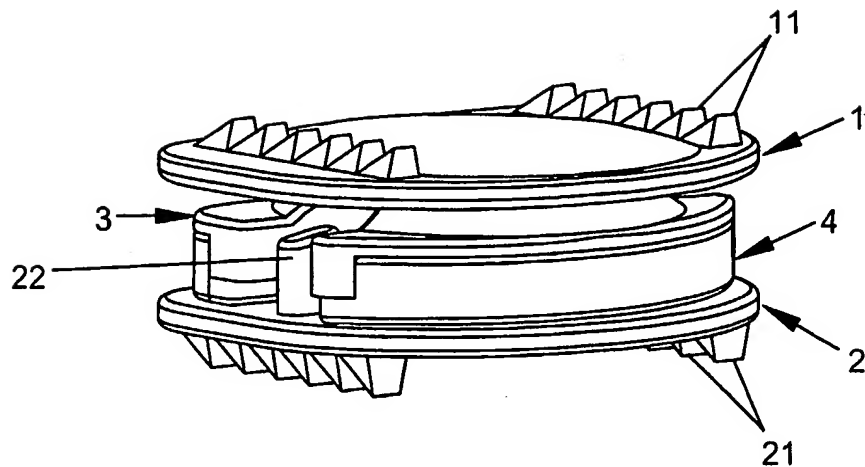


FIGURE 1B

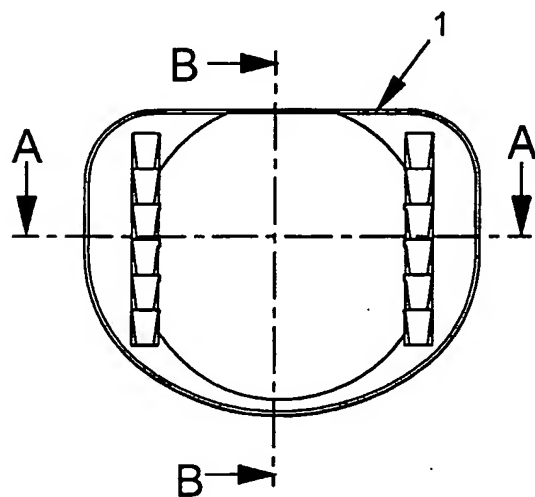


FIGURE 1C

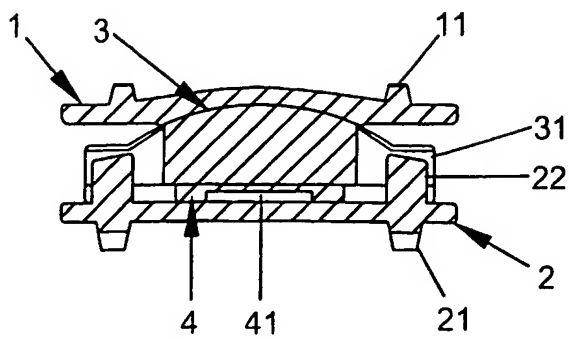
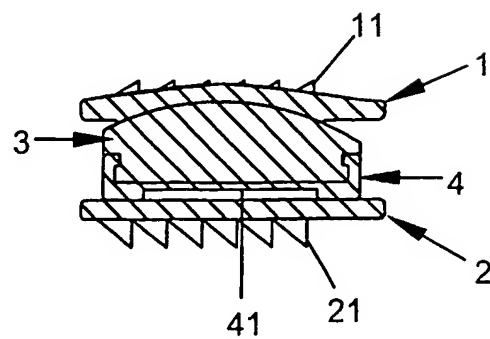


FIGURE 1D



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FIGURE 2A

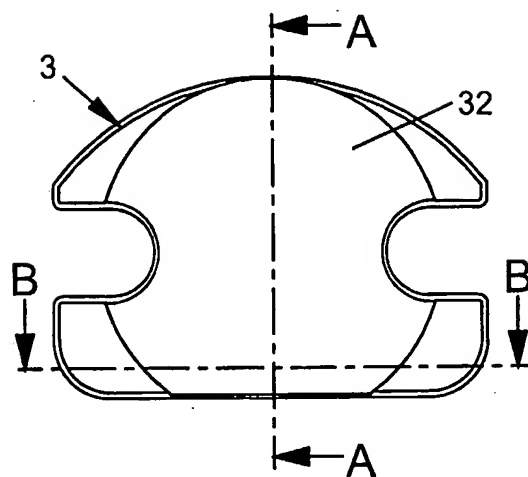


FIGURE 2B

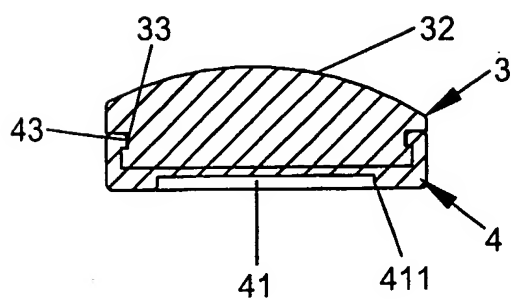


FIGURE 2C

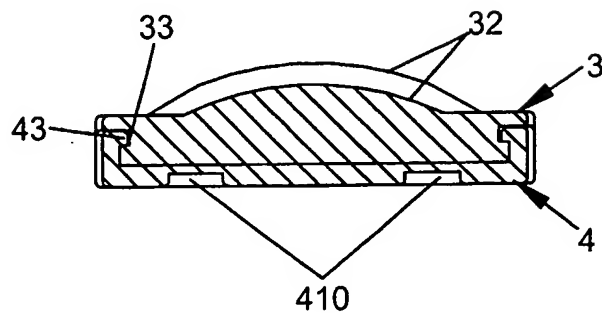


FIGURE 2D

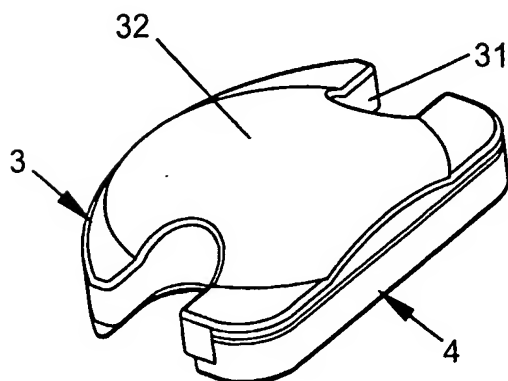
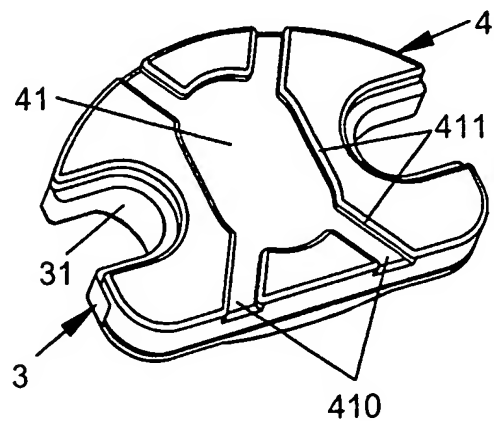


FIGURE 2E



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FIGURE 3A

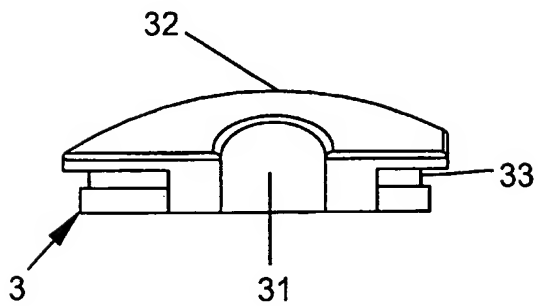


FIGURE 3B

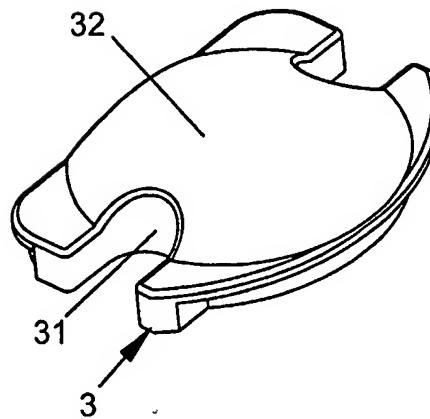


FIGURE 3C

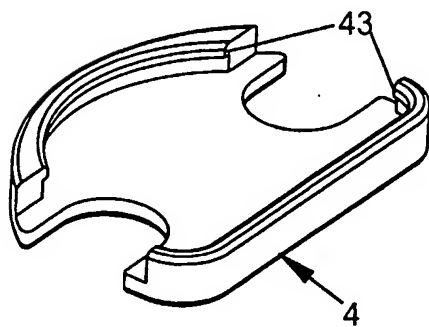
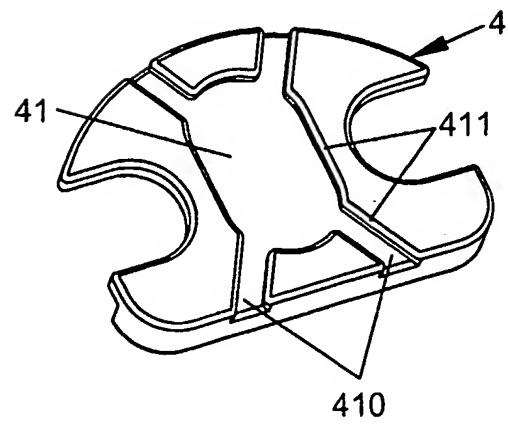


FIGURE 3D



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FIGURE 4A

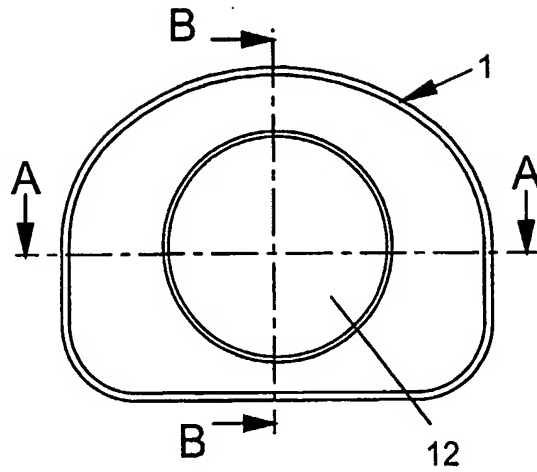


FIGURE 4B



FIGURE 4C

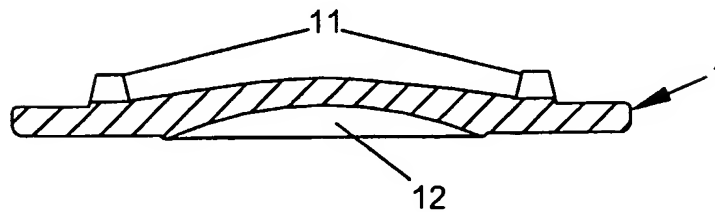
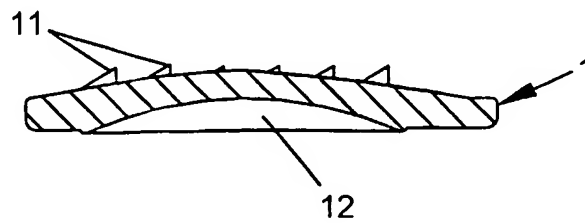


FIGURE 4D



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FIGURE 5A

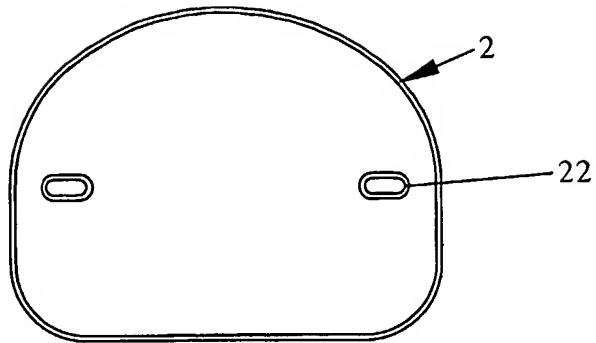


FIGURE 5B

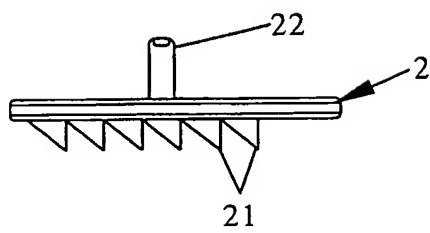


FIGURE 5C

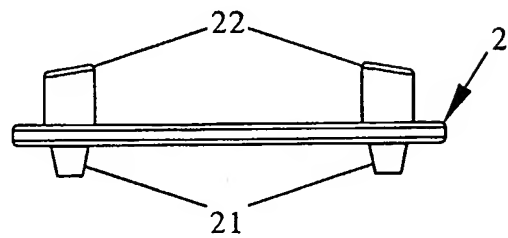


FIGURE 5D

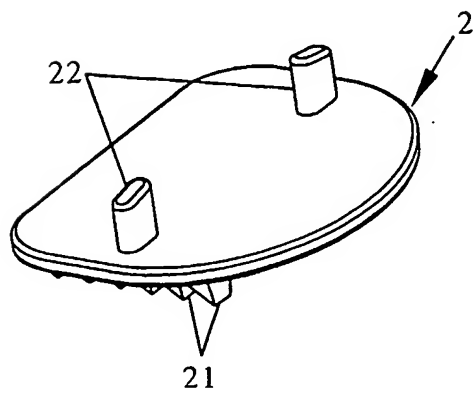
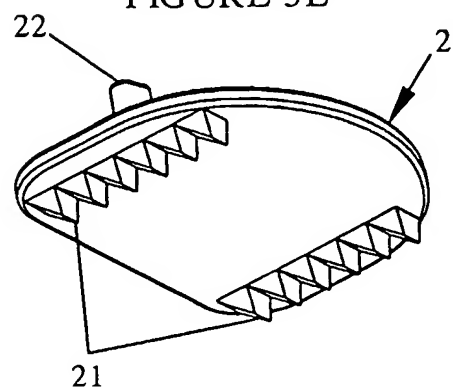


FIGURE 5E



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FIGURE 6A

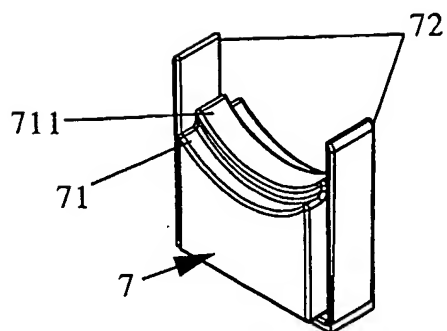


FIGURE 6B

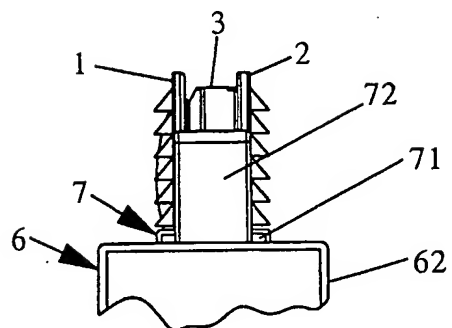


FIGURE 6C

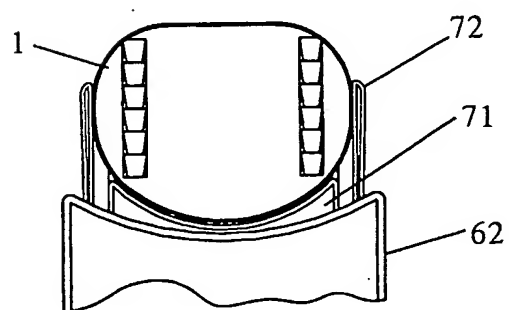
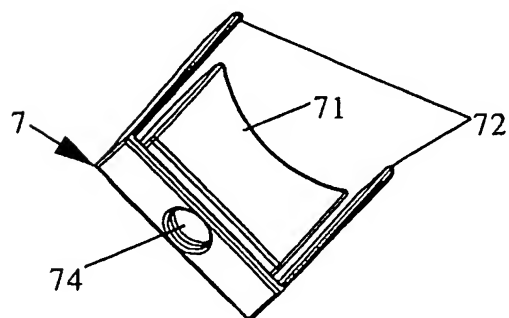


FIGURE 6D





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FIGURE 7A

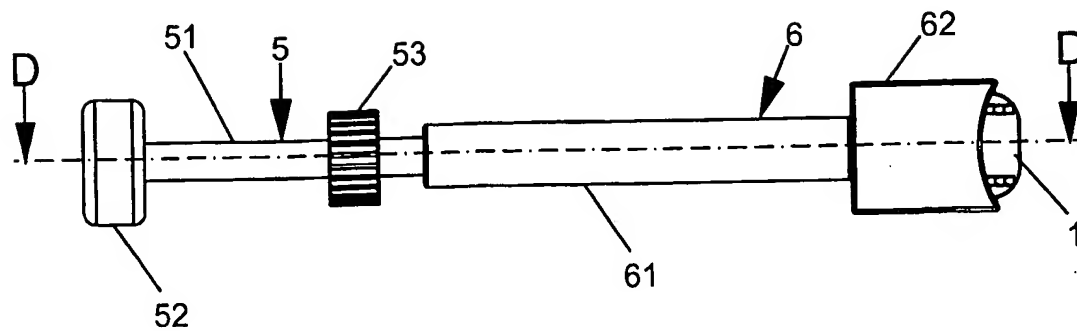


FIGURE 7B

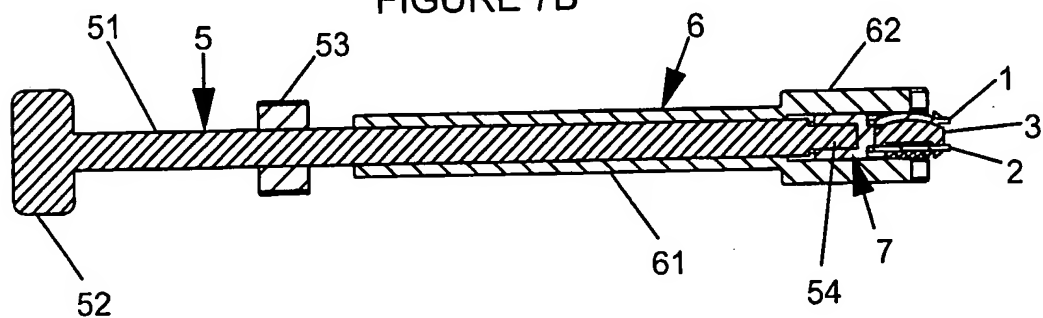


FIGURE 7C

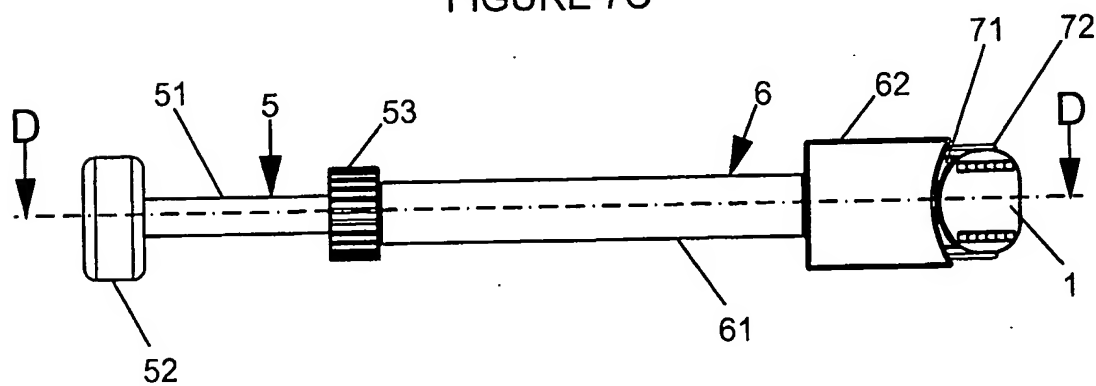
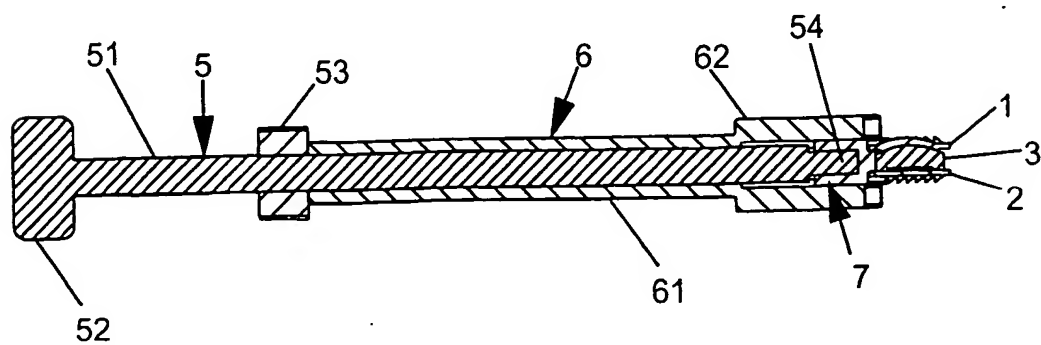


FIGURE 7D



## INTERNATIONAL SEARCH REPORT

Internat. Application No

PCT/IB2005/000280

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61F2/44 A61F2/46

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.             |
|------------|---|-----------------------------------|
| A          | WO 02/089701 A (CHATAIGNIER HERVE ;ALLAIN JEROME (FR); DELECRIN JOEL (FR); LDR MED)<br>14 November 2002 (2002-11-14)<br><br>page 8, line 27 - page 14, line 21<br>page 24, line 4 - line 6<br>----- | 1,8,<br>10-12,<br>15,16,<br>20-22 |
| A          | US 2003/220691 A1 (GEPHART MATTHEW P ET AL)<br>27 November 2003 (2003-11-27)<br><br>page 66 - page 74<br>-----<br><br>-/--  | 1-3,<br>5-11,17,<br>18,26         |

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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Date of the actual completion of the international search

13 April 2005

Date of mailing of the international search report

24.06.2005

Name and mailing address of the ISA

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Authorized officer

Buchmann, G

## INTERNATIONAL SEARCH REPORT

Internati . application No

PCT/IB2005/000280

| C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT |   |                           |
|--|---|---------------------------|
| Category *   | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.     |
| A  | FR 2 787 021 A (DIMSO SA)<br>16 June 2000 (2000-06-16)<br><br>page 1, line 27 - page 2, line 7<br>page 6, line 24 - page 10, line 16<br>page 12, line 19 - line 28<br>page 13, lines 14-16<br><br>----- | 11,14,<br>17-19,<br>23-25 |
| A  | WO 03/059212 A (SDGI HOLDINGS INC<br>;EISERMANN LUKAS (US); RAY EDDIE F III<br>(US)) 24 July 2003 (2003-07-24)<br>page 6, line 25 - page 8, line 21<br>page 13, line 26 - page 14, line 16<br><br>----- | 1,6,13                    |
| A  | EP 0 566 810 A (SULZER MEDIZINALTECHNIK<br>AG) 27 October 1993 (1993-10-27)<br>figures<br><br>-----   | 13                        |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB2005/000280

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-27

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-27

An intervertebral disc prosthesis comprising two endplates and core, having a flat and a curved articulating surface between said elements, wherein the flat surface of the core is provided with a blind hole for facilitating sliding of the core on the corresponding plate.

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2. claims: 28-32

An insertion device for an intervertebral disc prosthesis comprising two endplates and a mobile core, the insertion device comprising a clip, the front surface of which is shaped to fit the form of the prosthesis and which is provided with gripping means for gripping the prosthesis.

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## INTERNATIONAL SEARCH REPORT

Internati application No

PCT/IB2005/000280

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